A DOUBLET C0 IR SOLUTION USING EXISTING MAGNETS II

— THE SEQUEL —

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Possibilities for creating collisions at C0 by pilfering magnets from one of the existing IR's to create doublet C0 optics were examined previously in Fermilab TM-2181 : "A Doublet C0 IR Solution using Existing Magnets". That document details the IR magnet layout, injection & collision optics, and complications with beam separation schemes for C0-only collisions.

The current report discusses (very briefly) the alternate operating scenario, wherein collisions would occur at CDF but not at C0 simultaneously.

INJECTION OPTICS @ C0

With CDF tuned to collision optics (β^* = 0.35 m) and C0 set at injection optics (β^* = 6.00 m), one possible beam separation scheme is given in Figure 1 & Table 1.

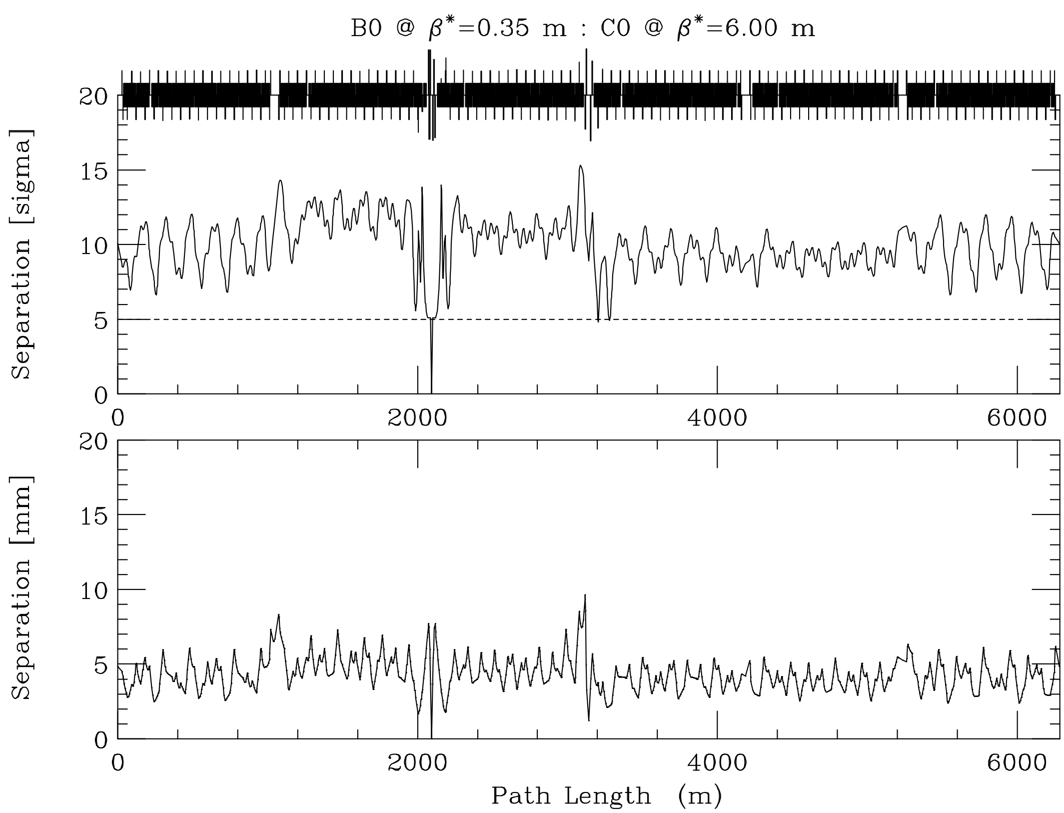

Figure 1. CDF optics tuned to ß* = 0.35 m & C0 @ ß* = 6.00 m.

Separator Gradients (MV / m)					
Horizontal			Vertical		
B11	2	4.	B11	1	4.
B17	4	-1.			
B49	2	3.	B49	1	2.5
C11	1	0.	C11	2	-2.5
			C17	4	0.
D17	2	-1.0139			
			D48	1	1.5781
			E17	2	-3.3709
A0	2	-3.0555			
			A17	2	4.
A49	1	-4.	A49	2	-4.

Table 1. CDF optics tuned to ß* = 0.35 m & C0 @ ß* = 6.00 m.

These separator gradients produce half–crossing angles at CDF of (x'*,y'*) = (-170,-170) µrad to give 5σ of separation at the 1st parasitic crossing for 20π µm (95%, normalized) beams. Through E- & F-sextants, in particular, beam separation is not as large as one would like to see. And in the C1 region separation again drops to just 5σ. Five sets of separators are required to run at their maximum gradients of 4 MV/m, and the helix solution is complicated by the B49 vertical separator being rolled through 45^{o}, which couples the transverse planes.

'DE-TUNED' OPTICS @ C0

TM-2181 discusses how the phase advance between separators and IP's degrades when one IR is moved from D0 to C0. Here, as was the case found in the earlier study, a much preferred helix solution is obtained if the inactive IR is 'de-tuned' to resemble Collins or Fixed-Target optics. The nominal operating tunes of (μ_x, μ_y) = (20.585, 20.575) are re-established using the F & D tune quad strings to add a half-integer globally around the ring. The parameters for de-tuned optics at C0 are given in Appendix A.

The separator solution corresponding to de-tuned C0 optics is shown in Figure 2 & Table 2. This solution again has half–crossing angles of (x'*,y'*) = (-170,-170) µrad to create 5σ separation at the 1st crossing. Elsewhere in the ring, with the glaring exception of A0, separation doesn't drop below 9σ, with the average being ~11σ. Separator gradients are very modest except for those either side of the IP, and the solution does not involve any of the rolled separators around C0.

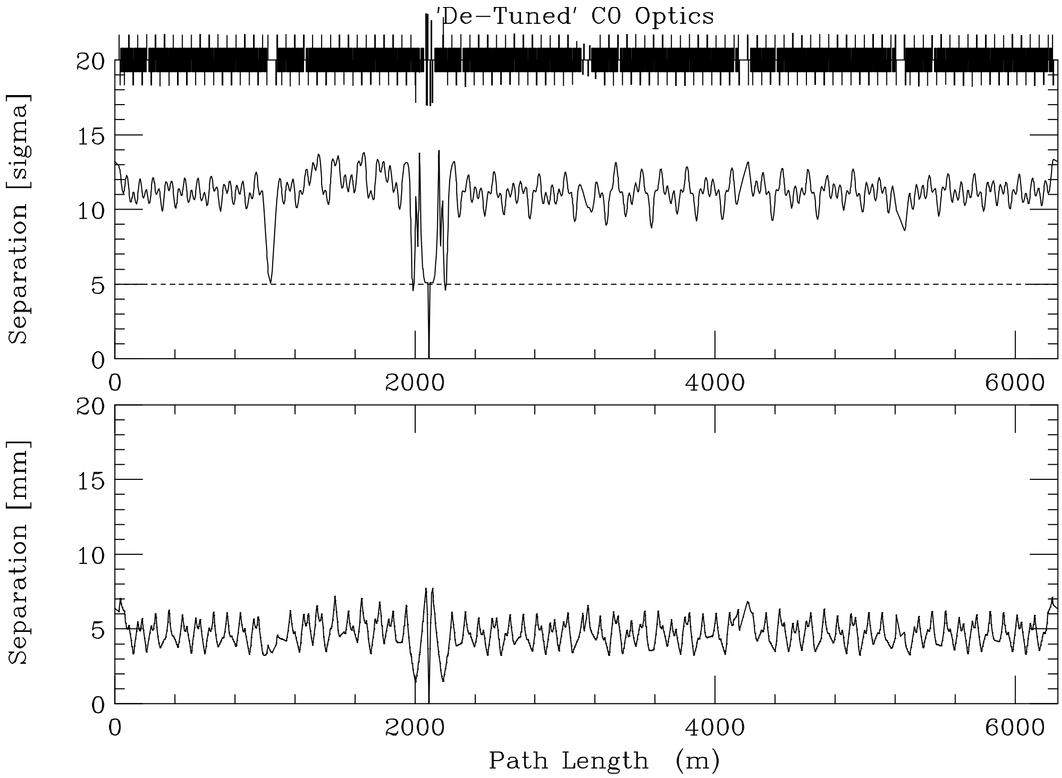

Figure 2. CDF optics tuned to ß* = 0.35 m & 'de-tuned' C0 optics.

Separator Gradients (MV / m)					
Horizontal			Vertical		
B11	2	4.	B11	1	4.
B17	4	-0.70180			
B49	2	0.	B49	1	0.
C11	1	0.	C11	2	0.
			C17	4	0.02494
D17	2	0.			
			D48	1	0.
			E17	2	0.
A0	2	-0.06509			
			A17	2	1.90010
A49	1	-4.	A49	2	-4.

Table 2. CDF optics tuned to ß* = 0.35 m & 'de-tuned' C0 optics.

The beam separation at A0 may be a non-issue. If, as is currently planned, the high-beta optics at A0 are replaced with a standard Collins straight, the separation at A0 improves to >7σ. This result is pictured below in Figure 3.

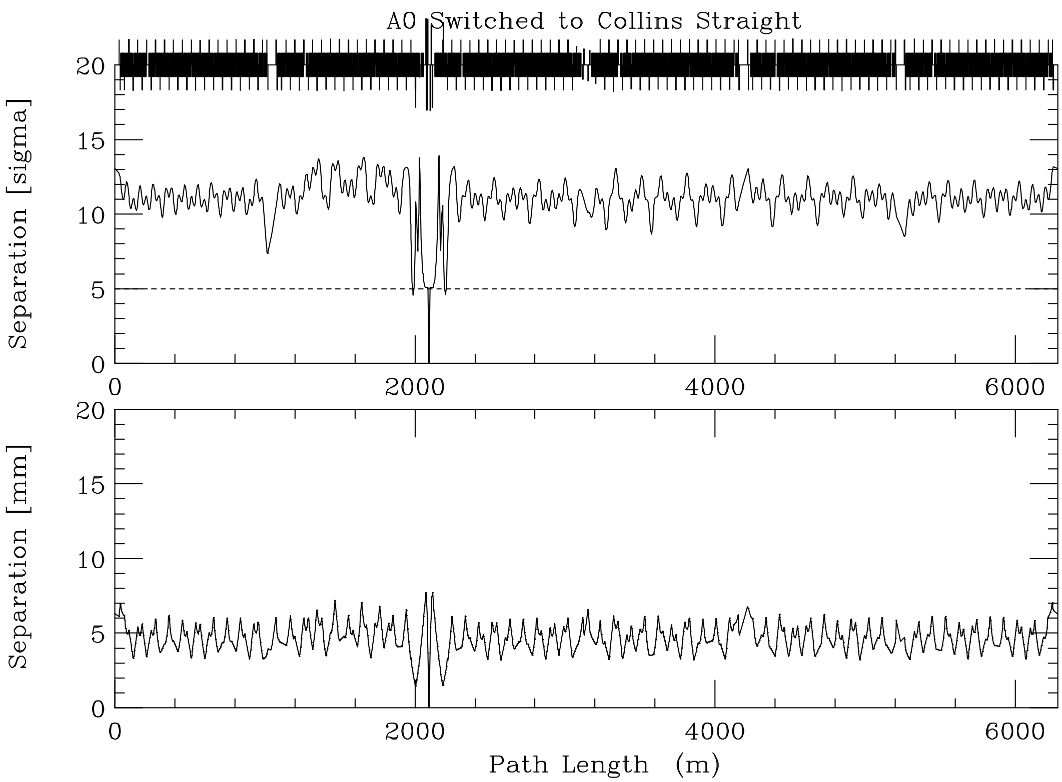

Figure 3. CDF @ ß* = 0.35 m, 'de-tuned' C0 optics, and Collins Straight installed at A0.

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APPENDIX A : PARAMETERS OF THE DE-TUNED C0 LATTICE

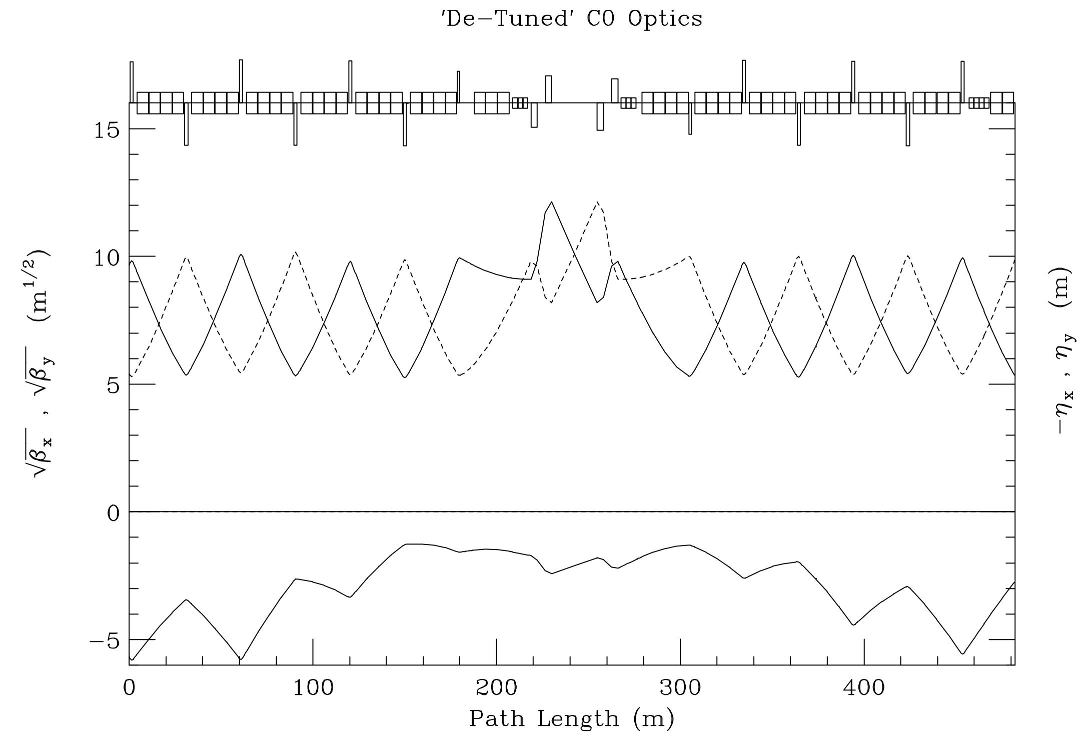

Figure A1. 'De-Tuned' C0 optics.

Quad #	C0 Gradients up (T/m)	C0 Gradients down (T/m)
Q4	48.9819	-48.9819
Q3		
Q2	-44.1882	44.1882
Q1		
Q5	56.8534	-56.8534
Q6	0.0	0.0
QT6	0.0	0.0
QT7	0.0	0.0
QT8	0.0	0.0
QT9	0.0	0.0
QT0	0.0	0.0

Table A1. Quadrupole gradients for the 'De-Tuned' C0 lattice[1].

[1] Shaded entries are sites where magnets have been removed from the usual CDF/D0 triplet IR configuration.